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DALL SHEEP SURVEY, GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE,  
ALASKA-1987

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A Dall sheep population survey was conducted in a portion of Gates of the Arctic National Park and Preserve (GAAR) from 4 to 12 July 1987. The objectives of the survey were: 1) to estimate abundance and population composition of sheep in count units 1, 2, 5, and 27 (Figures 1, 2, and 3) as delineated by Singer (1984) and 2) to assess the repeatability of survey results by recounting a small, randomly determined portion of the above survey area.

#### METHODS

The survey was conducted using a Bell 206 Jet Ranger helicopter, piloted by Bud Lofstedt of Kenai Helicopters, and utilized 3 observers in addition to the pilot. Observers included Judy Alderson (GAAR Resource Management Specialist), Bruce Dale (Wildlife Biotechnician), Mike Kunz (GAAR Archeologist) and myself. One observer classified sheep from the front left seat, a second observer verified those classifications from directly behind the first observer, and the third observer mapped locations of observed sheep. I classified, or verified the classification, for the entire survey to provide continuity.

When sheep were observed, the classifier recorded the total number and composition of the group using a small hand-held cassette tape recorder and the group's location was marked on a 1:250,000 USGS topographic map. Sheep were classified as lambs, yearlings, ewes, rams and unclassified sheep. Rams were further subdivided into four classes including: Class I =  $<1/4$  curl, Class II =  $1/4-1/2$  curl, Class III =  $1/2-3/4$  curl, and Class IV =  $>3/4$  curl. Sheep classified as yearlings were intermediate in body size to lambs and ewes and had shorter horns than ewes. However, there was a wide range of body sizes for animals classified as yearlings and it is possible that some larger yearlings were misidentified as ewes. These classification errors would tend to inflate the number of ewes counted, since it is not as likely that ewes would be misidentified as yearlings. Therefore, ratios with ewes as the basis may be underestimates.

Prior to the survey, the four count units were subdivided into a total of 24 subunits ranging in size from 41 to 199 km<sup>2</sup> (Figures 1, 2, and 3). The intent of the subunits was to enable completion of the subunit survey in a continuous effort while maintaining a constant search intensity and allowing for breaks between subunits to minimize observer fatigue. Subdivisions were made utilizing creek bottoms in most cases and ridgelines only where necessary.

Subunits were selected randomly from Units 2 and 5 for recounting. Units 1 and 27 were not considered because of localized poor weather and the long ferry time to the area, respectively.

The total survey time within each subunit was recorded. In addition, the time spent searching for sheep was recorded using a stopwatch, to determine search time for each subunit. Search time was the total survey time in a unit minus the time required to classify each group of sheep. Classifying time began when a group was initially observed and ended when the sheep had been classified and searching for the next group resumed.

#### SURVEY CONDITIONS

Weather conditions varied during the course of the survey and survey efforts were curtailed if low clouds or fog obscured any of the area to be surveyed.

A summary of daily conditions is as follows:

4 July 1987: Clear skies with little wind. Some problems with shadows and glare. Subunits surveyed: 2C, 5A, 5B.

5 July 1987: Occasional clouds at ridgetop level, otherwise clear. Again some problems with shadows and glare. Subunits surveyed: 1D, 1E, 2A, 2B, 2D, 2E.

6 July 1987: Clear skies with little wind. Some problems with shadows and glare. Subunits surveyed: 1A, 1F.

7 July 1987: Clear skies with little wind in the morning progressing to high scattered clouds and north winds at 10-15 kts by afternoon. Subunits surveyed: 1B, 1C, 1F, 1G, 1H, 1I.

8 July 1987: Clear skies early trending toward scattered high overcast conditions with periodic light rain. Subunits surveyed: 27E, 27F, 27G, 27H.

9 July 1987: Scattered high clouds developing into solid cloud cover and light rain followed by clearing conditions. Subunits surveyed: 27A, 27B, 27C, 27D.

10 July 1987: Weathered out.

11 July 1987: Weathered out.

12 July 1987: Scattered high clouds with occasional clouds down to 5400 feet. Conditions improved throughout the day. Subunits surveyed: 2A recount, 2B recount, 5A recount.

## RESULTS

A total of 1228 Dall sheep were counted during the initial survey (Table 1) resulting in a density estimate of 0.6 sheep/km<sup>2</sup> for the entire survey area. Lambs and yearlings were abundant resulting in a lamb:yearling:ewe ratio of 47:27:100 (Table 2). Ratios of lambs and yearlings to ewes ranged from 36 to 51:100 and from 9 to 36:100, respectively, for the four count units.

Rams comprised 35% of the sheep observed. Rams occurred in nearly equal proportion to ewes overall (92 rams:100 ewes), but the ram:ewe ratio within count units varied from 58 to 181 rams:100 ewes. Rams larger than 3/4 curl accounted for 50% of the rams seen (Table 2).

## Unit Summaries

Unit 1 (Figure 1) contained over half of the sheep observed and had the highest sheep density of the four units surveyed (Table 4). The unit contained many nursery groups and therefore, had the highest lamb:yearling:ewe ratio and smallest proportion of rams (Table 2).

Sheep were found in moderate density in Unit 2 (Figure 1).

Lamb:yearling:ewe ratio was about average for the entire survey area, but the proportion of rams observed was high (Table 2). Rams over 3/4 curl accounted for 57% of the rams observed.

Unit 5 (Figure 2) had a low density of sheep. Although the density of rams was the lowest in any count unit, the proportion of large rams was the highest (Table 2). The lamb:yearling:ewe ratio was the lowest of any unit surveyed.

Dall sheep occurred at a low density in Unit 27 (Figure 3). The ratio of lamb to ewes was high, and the ratio of yearlings to ewes was moderate for the units surveyed (Table 2). Rams greater than 3/4 curl accounted for 58% of the rams observed.

#### Survey Time and Search Rate

A total of 26.8 hours were spent actually conducting this survey, not including any ferry time. Search rate averaged 1.7 km<sup>2</sup>/min for the survey although it varied widely from 1.0 to 3.2 km<sup>2</sup>/min (Table 4) for individual subunits.

Subunits were designed with the goal that the survey time within any subunit would not exceed 90 minutes. However, two of the subunits (2C and 2D) require slightly more time, and two others (1D and 5A) required substantially more time than the goal. These last two units should be further subdivided for future surveys.

#### Comparison of Initial Surveys and Resurveys

Results of initial surveys of three subunits and the subsequent resurvey of those units 7-8 days later are summarized in Table 5. Twenty-nine percent fewer sheep were observed during the repeat survey. Ratios and proportions determined by pooling all observations in these units for the initial survey and for the resurvey varied widely except for yearling:ewe ratio. In particular, ram:ewe ratio varied from 78:100 for the initial survey to 205:100 for the resurvey.

Most of the difference in total numbers is due to the large decrease in the number of sheep observed in subunit 2B between the 2 surveys. This difference could be explained by the movement of 3 nursery groups, observed in the original survey, out of the count area by the time of the resurvey. However, even in the two remaining units where total numbers observed varied little between the 2 surveys, the composition of sheep observed were quite different. For example, in subunit 5A, only 3 (4%) fewer sheep were observed during the resurvey, but the number of rams observed increased by 10 (32%) and the number of ewes decreased by 13 (41%).

#### Comparisons Between 1982 and 1987 Surveys

During this survey, 27% more sheep were observed than in 1982 when Singer (1984) surveyed these areas (Tables 2 and 3). It is difficult if not impossible to determine the actual change in population between the two survey periods. For three units that Singer (1984) provided 1982 survey times (Units 1,2, and 5), the survey time was 50% greater and 36% more sheep were observed in 1987 than in 1982. The

relationship between survey time and the number of sheep observed is complex since: 1) survey time includes both time spent searching for sheep and time required to classify sheep; 2) classification time will increase with the number of sheep observed; and 3) once above a low search rate, search time and total number of sheep observed are probably related in a curvilinear fashion with the increment in sheep observed declining with each increment in search time.

Some differences between 1982 and 1987 surveys in the composition of sheep observed were noted. The overall lamb:ewe ratio was higher in 1987 than 1982 while the yearling:ewe ratio was similar (Tables 2 and 3). The ratio of rams to ewes was higher overall in 1987 while the size composition of rams observed was similar, except for Class 1 rams. This difference may represent a more conservative approach to separating small rams from ewes and yearlings in the 1987 survey than in the 1982 survey, rather than a real difference in this component of the ram population.

#### DISCUSSION

Based on the data collected during this survey, lambs were abundant in 1987 and the production and survival to yearling age of the 1986 cohort was reasonable. Rams exist in a similar density to ewes and large, older rams constitute half of the ram component of the population. Minimum densities of sheep ranged from 0.3 sheep/km<sup>2</sup> in units 5 and 27 to 0.8 sheep/km<sup>2</sup> in unit 1.



This survey is a good example of the difficulties in making interpretations of such data, beyond those summarized above. First, it is not possible to assess population trend with the data at hand. Comparisons between surveys, such as this survey and the 1982 survey of the same area, are clouded by differences in survey time and therefore, a difference in search rate. This problem can be addressed by research to determine the relationships between search rate and sightability of various age and sex classes of sheep. Further, with the present methods, no assessment of the precision of a given estimate is produced. Replicate surveys to assess the variability in estimates of population parameters are necessary to evaluate this precision. Without this information, it is impossible to determine whether a perceived change in the sheep population is real or within the limits of random variation of the estimates. The limited effort to resurvey subunits during this survey provided evidence that the number of sheep observed and the various ratios of interest may be highly variable. However, variation in these estimates may be less if larger areas are resurveyed. Further investigation of these problems and development of appropriate survey methods for Dall sheep are sorely needed if the inventory and monitoring of sheep populations are a management need.

#### LITERATURE CITED

- Singer, F.J. 1984. Aerial Dall sheep count, 1982, 1983, and 1984, Gates of the Arctic National Park and Preserve. Nat. Res. Survey and Inventory Rep. AR/84-2. Natl. Park Serv., Anchorage AK. 20pp.

Table 1. Results of aerial sheep survey in Gates of the Arctic National Park, Alaska, July 1987.

Count	Total	RAM CLASSES <sup>1</sup>											
		Unit	sheep	Lambs	Yearlings	Ewes	Rams	Unclass.	1	2	3	4	
1A	63	16			9	25	13	0	0	4	2	7	
B	131	40			22	65	4	0	0	4	0	0	
C	48	3			5	5	35	0	2	6	11	16	
D	199	42			16	109	32	0	2	10	7	13	
E	82	11			20	27	24	0	0	5	10	9	
F	0	0			0	0	0	0	0	0	0	0	
G	44	18			7	19	0	0	0	0	0	0	
H	98	10			16	23	49	0	7	12	17	13	
I	1	0			0	0	1	0	0	0	0	1	
TOTAL	666	140			95	273	158	0	11	41	47	59	
2A	51	0			4	1	46	0	0	5	16	25	
B	105	31			8	66	0	0	0	0	0	0	
C	75	4			3	18	48	2	0	6	12	30	
D	23	0			0	1	21	1	0	2	7	12	
E	10	0			0	0	10	0	0	2	4	4	
TOTAL	264	35			15	86	125	3	0	15	39	71	
5A	82	16			3	32	31	0	0	2	7	22	
B	31	1			1	15	14	0	1	2	5	6	
TOTAL	113	17			4	47	45	0	1	4	12	28	
27A	22	0			0	0	22	0	0	2	2	18	
B	86	23			9	48	5	1	1	1	1	2	
C	22	0			0	0	22	0	0	1	6	15	
D	9	0			0	0	9	0	1	2	1	5	
E	0	0			0	0	0	0	0	0	0	0	
F	15	1			0	3	11	0	2	5	2	2	
G	30	2			0	2	26	0	1	5	6	14	
H	1	0			0	0	1	0	0	0	1	0	
TOTAL	185	26			9	53	96	1	5	16	19	56	
GRAND TOTAL	1228	218			123	459	424	4	17	76	117	214	

1. Class 1 = <1/4 curl, Class 2 = 1/4-1/2 curl, Class 3 = 1/2-3/4 curl,

Class 4 = >3/4 curl.

Table 2. Composition of Dall sheep observed during helicopter survey, Gates of the Arctic National Park and Preserve, Alaska, during 4-9 July 1987.

Count Unit	Total Sheep	L:Y:E <sup>1</sup> ratio	Ram:Ewe ratio	% of Rams <sup>2</sup>				Ram % of total
				1	2	3	4	
1	666	51:35:100	58:100	7	26	30	37	24
2	264	41:17:100	145:100	-	12	31	57	47
5	113	36: 9:100	96:100	2	9	27	62	40
27	185	49:17:100	181:100	5	17	20	58	52
Total	1228	47:27:100	92:100	4	18	28	50	35

<sup>1</sup> L:Y:E = Lambs:Yearlings:Ewes.

<sup>2</sup> Ram Classes: 1=<1/4 curl, 2=1/4-1/2 curl, 3=1/2-3/4 curl, 4=>3/4 curl.

Table 3. Composition of Dall sheep observed in selected count units during helicopter survey, Gates of the Arctic National Park and Preserve, summer 1982 (Singer 1984 and unpublished data).

Count Unit	Total Sheep	L:Y:E <sup>1</sup> ratio	Ram:Ewe ratio	% of Rams <sup>2</sup>				Ram % of total
				1	2	3	4	
1	355	41:32:100	69:100	22	21	23	34	28
2	199	40:20:100	68:100	2	21	34	43	30
5	211	46:21:100	46:100	9	20	16	55	21
27	202	34:30:100	137:100	1	7	26	66	46
Total	967	41:26:100	75:100	10	17	25	49	31

<sup>1</sup> L:Y:E = Lambs:Yearlings:Ewes.

<sup>2</sup> Ram Classes: 1=<1/4 curl, 2=1/4-1/2 curl, 3=1/2-3/4 curl, 4=>3/4 curl. Unclassified rams ignored to determine percent in each class.

Table 4. Sheep densities, survey rates, and search rates derived for each subunit counted during a helicopter survey of Gates of the Arctic National Park and Preserve, Alaska, July 1987.

Count Unit	Total Sheep	Unit Area (km <sup>2</sup> )	Sheep Density (no./km <sup>2</sup> )	Survey Time (min)	Survey Rate (km <sup>2</sup> /min)	Search Time (min)	Search Rate (km <sup>2</sup> /min)
1A	63	113	43.5	89	1.3	67	1.7
B	131	59	22.7	59	1.0	44	1.3
C	48	69	26.5	63	1.1	43	1.6
D	199	140	53.8	132	1.1	75	1.9
E	82	95	36.5	84	1.1	56	1.7
F	0	122	46.9	59	2.1	59	2.1
G	44	64	24.6	62	1.0	51	1.3
H	98	83	31.9	90	0.9	69	1.2
I	1	44	16.9	28	1.6	28	1.6
Total	666	789	0.8	666	1.2	492	1.6
2A	51	88	33.8	46	1.9 <sup>1</sup>	—	—
B	105	141	54.2	63	2.2	59	2.4
C	73	112	43.1	105	1.1	80	1.4
D	23	102	39.2	67	1.5	65	1.6
E	10	41	15.8	33	1.2	31	1.3
Total	264	484	0.5	314	1.5 <sup>1</sup>	—	1.7 <sup>1</sup>
5A	82	199	76.5	145	1.4	125	1.6
B	31	134	51.5	68	2.0	49	2.7
Total	113	333	0.3	213	1.6	174	1.9
27A	22	93	0.2	37	2.5	29	3.2
B	86	65	1.3	49	1.3	34	1.9
C	22	86	0.3	61	1.4	47	1.8
D	9	50	0.2	53	0.9	45	1.1
E	0	77	0	52	1.5	52	1.5
F	15	46	0.3	50	0.9	41	1.1
G	30	76	0.4	88	0.9	73	1.0
H	1	75	0.0	26	2.9	26	2.9
Total	185	568	0.3	416	1.4	347	1.6
Grand Total	1228	2174	0.6	1609	1.3 <sup>1</sup>	—	1.7 <sup>1</sup>

<sup>1</sup> Since no search time was available for subunit 2A, the survey rates and search rates for unit 2 and the entire survey were determined by ignoring the survey time for subunit 2A.

Table 5. Results of initial and duplicate aerial surveys for Dall sheep, Gates of the Arctic National Park and Preserve, Alaska, July 1987.

Count Unit	Date	No. of Groups	Total Sheep	Sheep Class <sup>1</sup>					Ram Class <sup>2</sup>				Search Rate (km <sup>2</sup> /min)
				L	Y	E	R	U	1	2	3	4	
Initial Survey													
2A	7-5	12	51	0	4	1	46	0	0	5	16	25	—
2B	7-5	13	105	31	8	66	0	0	0	0	0	0	2.4
5A	7-4	22	82	16	3	32	31	0	0	2	7	22	1.6
Total		47	238	47	15	99	77	0	0	7	23	47	
Resurvey													
2A	7-12	15	47	2	0	5	40	0	3	6	15	16	3.1
2B	7-12	8	44	13	2	20	9	0	0	4	1	4	3.0
5A	7-12	19	79	12	6	19	41	1	1	5	14	22	1.8
Total		42	170	27	8	44	90	1	1	15	30	42	

Comparison of Derived Population Estimates and Ratios

	Initial Survey	Resurvey
Population Estimate	238	170
Density (Sheep/km <sup>2</sup> )	0.56	0.40
L:Y:E Ratio <sup>1</sup>	47:15:100	61:18:100
Ram:Ewe Ratio	78:100	205:100
% Ram Classes (1:2:3:4) <sup>2</sup>	0:9:30:61	1:17:33:47
Ram % of Total	32	53

<sup>1</sup> L=Lambs, Y=Yearlings, E=Ewes, R=Rams, U=Unclassified.

<sup>2</sup> 1=<1/4 curl, 2=1/4-1/2 curl, 3=1/2-3/4 curl, 4=>3/4 curl.

Count on Lake 1-5-4  
D-6-5-4

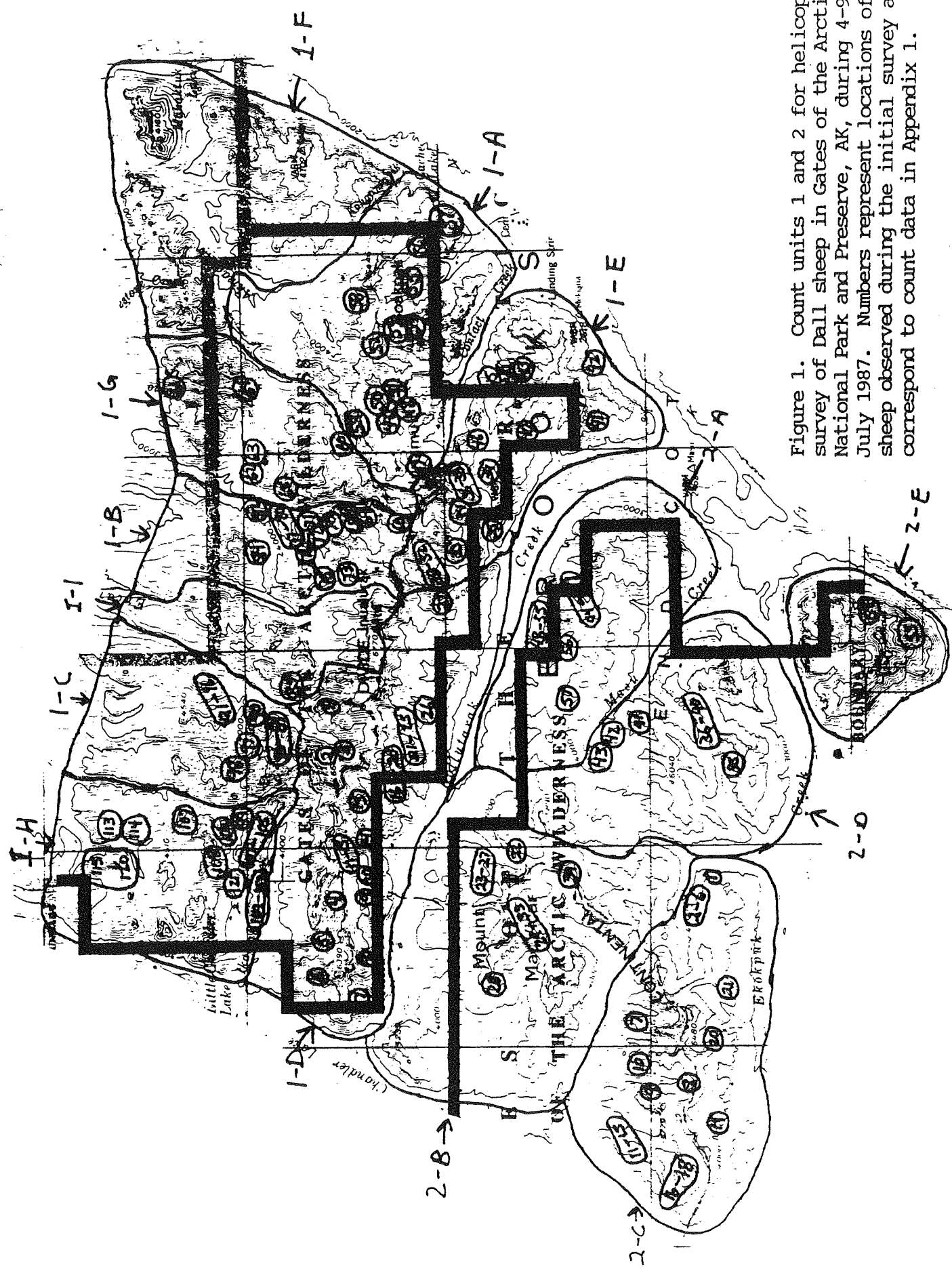


Figure 1. Count units 1 and 2 for helicopter survey of Dall sheep in Gates of the Arctic National Park and Preserve, AK, during 4-9 July 1987. Numbers represent locations of sheep observed during the initial survey and correspond to count data in Appendix 1.

Chukchi L. A-6,5  
 Wainwright D-6,5  
 Survey Pass D-1  
 Killik R. A-1

Unit 5

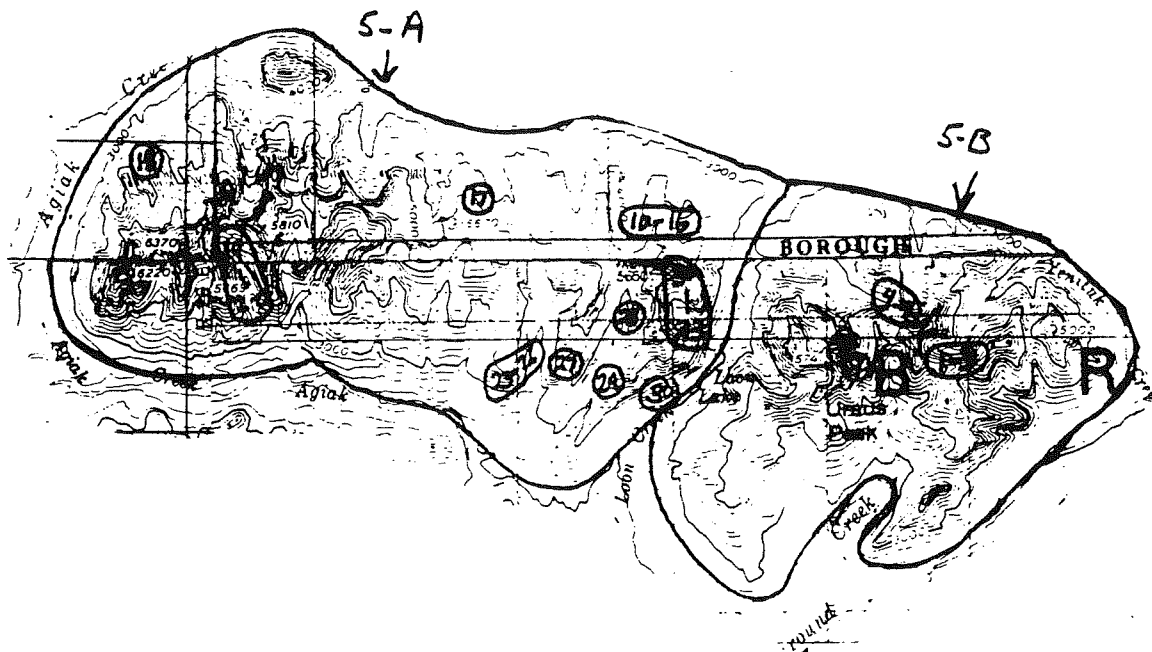


Figure 2. Count unit 5 for helicopter survey of Dall sheep in Gates of the Arctic National Park and Preserve, AK, during 4-9 July 1987. Numbers represent locations of sheep observed during the initial survey and correspond to count data in Appendix 1.

K. H. R. A-2-3

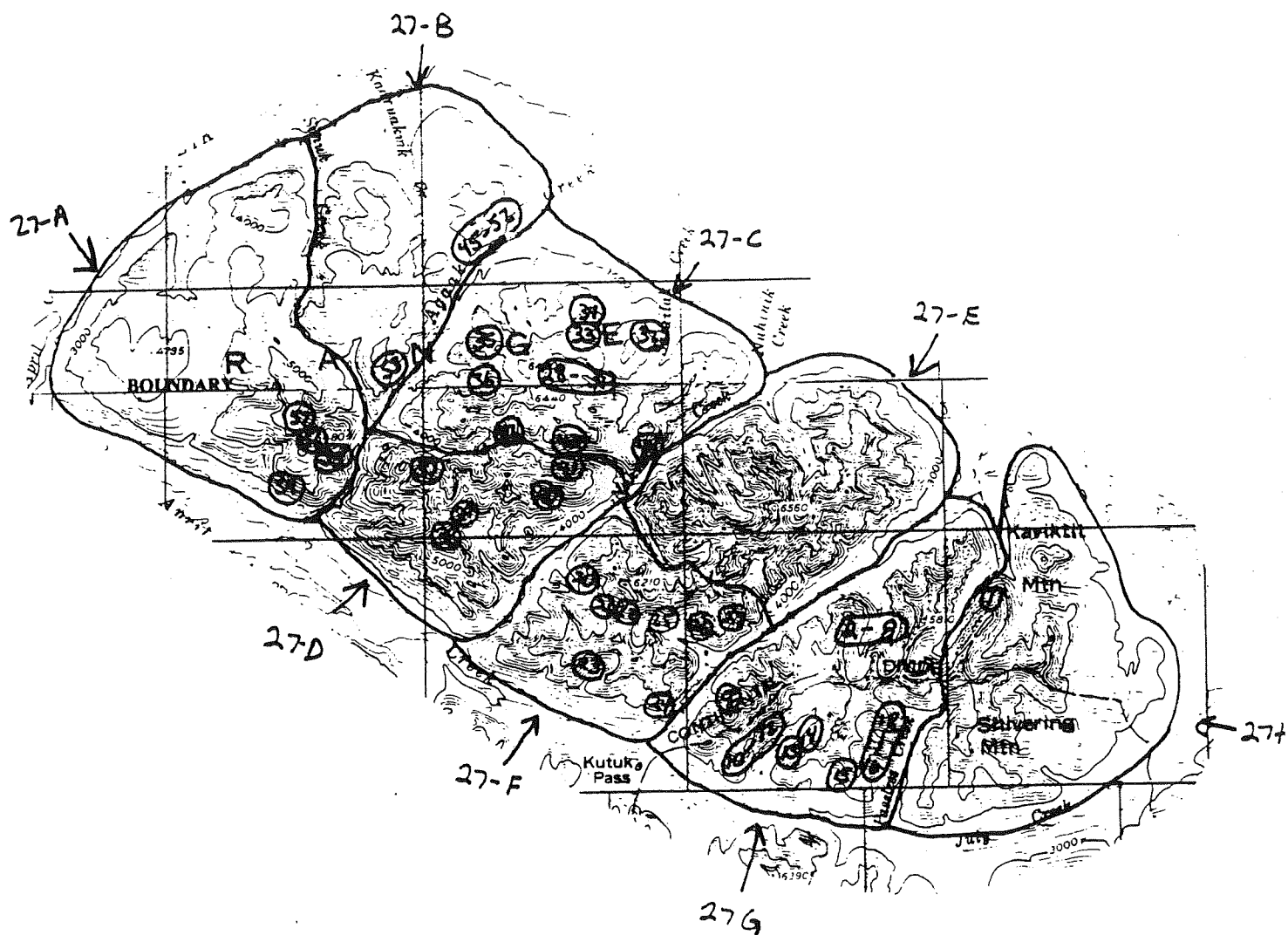


Figure 3. Count unit 27 for helicopter survey of Dall sheep in Gates of the Arctic National Park and Preserve, AK, during 4-9 July 1987. Numbers represent locations of sheep observed during the initial survey and correspond to count data in Appendix 1.



Locations of Dall sheep groups observed in Count Units 2A, 2B, and 5A during resurvey effort, Gates of the Arctic National Park and Preserve, AK, 12 July 1987. Numbers correspond to groups listed in Appendix 2.

